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Evaluation of K efficient genotypes for improving growth, tuber yield and starch content of cassava (*Manihot esculenta* Crantz.)

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Abstract
Cassava or tapioca (*Manihot esculenta* Crantz.) is one of the most important tuber crops belongs to the family Euphorbiaceae which is grown widely in tropical countries. This crop is cultivated both in irrigated and rainfed conditions and has wider adaptability to poor soil condition, tolerance to drought, pest and diseases. A field experiment was conducted at Tapioca and Castor Research Station, Yethapur with an objective to identify the suitable K efficient lines of cassava with maximum growth, tuber yield and starch content. The trial was laid out in Randomized Block Design (RBD). The eight K efficient accessions are evaluated along with Sree Athulya and local check (YTP 1) for its growth parameters *viz.*, plant height (cm), stem girth (cm), and yield traits *viz.*, number of tubers, tuber yield plant^{-1} (kg) and quality parameters *viz.*, starch content (%) and HCN content (ppm). The recommended dose of fertilizer for cassava is 90:90:240 kg of NPK ha^{-1}. In this experiment, K fertilizer was not applied to the plots and N and P fertilizers were applied as per the recommendations. The results revealed that the maximum plant height (217.80 cm) and stem girth (14.3 cm) was recorded in YTP 1. The maximum number of tubers (10.2) was recorded in TCa14-4 and the lengthiest tuber (40.6 cm) was observed in YTP 1. Among the K efficient lines evaluated, maximum tuber yield (42.90 t ha^{-1}) and minimum tuber yield (31.47 t ha^{-1}) was recorded in TCa14-6 and TCa14-8 respectively. The highest starch content (30.90%) was recorded in TCa14-5 and the lowest starch content (26.0%) was recorded in TCa14-2. The maximum K uptake was exhibited by TCa 14-6.

Keywords: Cassava, K efficient lines, tuber yield, starch content

Introduction
Cassava or tapioca (*Manihot esculenta* Crantz.) is one of the most important tuber crop belongs to the family Euphorbiaceae, which is having the climate resilient properties and are grown widely in tropical countries. This crop is well known for its adaptability to poor soil conditions, tolerance to drought, pest and diseases. Cassava is cultivated both in irrigated and rainfed conditions. In India, this crop is cultivated in Tamil Nadu, Kerala, Andhra Pradesh, Karnataka, Maharastra and Assam. In India, it is cultivated mainly in Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. Kerala and Tamil Nadu account for about 80% of the total acreage of the crop in India. During 2018-19, cassava is cultivated in an area of 1.73 lakh hectares with the production of 49.50 lakh tonnes (NHB, 2019).

Cassava is mainly grown in rainfed conditions as mono-crop year after year in the same field. Being a tuber crop, the tuber yield mainly depends on the nutritional status of soil and judicious application of fertilizers. Under the conditions of rising atmospheric temperature, escalating fertilizer prices and its marginal availability has resulted in imbalanced plant nutrition affecting tuber yield, soil health as well as farmers' income. Cassava is a heavy feeder that depletes the nutrients that are present in the soil, with a high efficiency in nutrient absorption on low nutrient soils, leaving them poor than before and contributes to the decline in soil fertility (Howeler, 2002 and Howeler, 2011) [2, 3]. Nutrient absorption depends on cassava growth rate, which in turn depends on climatic conditions, soil fertility and genotype. The nutrient removal is higher when yields are high because when fertility is high, the plant has a higher nutrient concentration. The increased tuber yield is obtained when potassium fertilizer is applied apparently and the application of potassium is necessary for the appreciable

response to nitrogen fertilization. Apart from the above, the quality of tubers is much depended on potassium nutrition. Tuber bulking and quality of starch is positively correlated with applied potassium. Mengel (1980) [7] observed that K favourably affect the synthesis and translocation of sugars.

Nair and Aiyer (1986) [12] recorded maximum tuber yield and starch content by the application of 100 kg of K_2O ha^{-1}. In Tamil Nadu, the area under Cassava cultivation has higher soil potassium content and thereby the proper utilization of soil potassium will be highly beneficial by the ways of reduced application and saving the cost of fertilizers. Considering its long duration and heavy application of nutrients, the above mentioned problem can be circumvented by growing suitable K efficient lines for achieving higher profit by the way of high tuber yield and starch content. Hence, the experiment was designed with the objective to evaluate the K efficient Cassava lines with the prevailing prominent local check varieties.

Materials and Methods

The field experiment was conducted consecutively for four years at Tapioca and Castor Research Station, Yethapur, Salem. This station is located in the agro climatic region of North Western Zone of Tamil Nadu with geo coordinates of 11º 35' N latitude, 78 º 29' E longitude and at an altitude of 282 meters above MSL. The planting was taken up during second week of December and the harvesting of tuber was done during the last week of September. The cassava setts of K efficient cassava lines were planted in ridges and furrows method at a spacing of 90 x 75 cm (90 cm between ridges and 75 cm between furrows). Experiment was laid out in Randomized Block Design (RBD) with three replications. During the time of harvest, observations on plant height, stem girth, number of tubers per plant, tuber yield and starch content were recorded. Standard cultivation practices were adopted uniformly for all experimental plots as per the recommendations in crop production techniques of Horticultural crops (2013). The recommended dose of fertilizer for cassava in Tamil Nadu is 90:90:240 kg of NPK ha^{-1}. In this experiment, the initial soil K was analyzed and K fertilizer was not applied to all the plots. The recommended quantities of N and P fertilizers were applied as per the recommendations. The plants were maintained with furrow irrigation method and the irrigations were given at weekly intervals from planting to three months after planting and subsequently at fifteen to twenty days interval until harvest. Final K is analyzed after the harvest of the crop and the experiment is repeated in the same plots without changing the design to avoid the variation in soil nutritional status. The data on various parameters recorded during the course of investigation were statistically analyzed according to Panse and Sukhatme (1985) [14].

Results and Discussion

Growth parameters

The experiment on the evaluation of K efficient lines of Cassava revealed that there was no significant difference on the plant height. The stem girth showed significant variation among the lines evaluated. The maximum stem girth (14.30 cm) was noticed in local check YTP 1. However in the K efficient lines, maximum stem girth (12.5 cm) was observed in TCa 14-5 and minimum stem girth (9.90 cm) was recorded in TCa 14-6 and Sree Athulya (Table 1).

Potassium plays an indirect role in the growth of plants and K deficiency reduces the plant height with narrow and fewer lobes (Onwnueme and Charles, 1994) [3]. High K utilization is the result of large dry matter production and high harvest index, besides it plays a distinct role in the opening and closing of stomata which depend upon gain or loss of turgor in guard cells (Hsiao, 1976) [4]. Poor application of K leads to reduced growth and size of leaves (Mandal, 2006) [6]. The present findings are in line with Nair and Aiyer (1986) [12] and Onwnueme and Charles, (1994) [3].

Yield and quality parameters

The yield of cassava is mainly determined by number of tubers, length of tuber and girth of tuber. The maximum number of tubers (10.2) was recorded in TCa 14-4 which was on par with TCa 14-6 (10.0) and TCa 14-1 (9.3). Among the lines evaluated, maximum tuber girth (24.5 cm) was noticed in YTP 1 and minimum tuber girth (11.6 cm) was noticed in TCa 14-7. The tuber yield was significantly influenced among the K efficient lines. The maximum tuber yield (42.90 t ha^{-1}) was recorded in TCa 14-6 which was followed by TCa 14-2 (39.32 t ha^{-1}) (Table 1). The tuber yield in Sree Athulya and YTP 1 is 36.53 t ha^{-1} and 38.74 t ha^{-1} respectively. The maximum starch content (30.9%) was recorded in TCa 14-5 followed by TCa 14-2 (29.4%). However, the local check YTP 1 recorded the starch content of 26.6%. The lowest (82.40 ppm) and the highest (117.50 ppm) HCN content was recorded in TCa 14-1 and Tca 14-8 respectively. K deficiency lead to poor root production and quality of tubers are highly influenced by the judicious application of potassium. Mengel (1980) [7] obtained similar results and K favourably affect sugar synthesis and translocation. In addition to the above, K increases the capillary movement of water nearest to the plant roots thereby the bulking of tuber will be favourably increased contributing to the higher tuber yield. Similar findings were reported by Takyi (1972) [15] and Mandal (2006) [6]. Proper utilization of K leads to decrease in HCN content of tuber. The present findings are in corroboration with the findings of Muthusamy *et al.* (1974) [10] and Lebot (2009) [5]. The higher tuber yield and starch content was observed in TCa 14-5 and TCa 14-6 which might be increased synthesis and translocation of carbohydrates by the extraction of potassium from the soil. This is in line with findings of Mohankumar *et al.* (1971) [8] and Mohankumar *et al.* (1975) [9].

The results of post harvest soil sample analysis revealed that the maximum K utilization was observed in TCa 14-6 (Fig 1). However, the poor K utilization was observed in TCa 14-8 which was followed by TCa 14-2 and TCa 14-7. Cassava has high requirement of potassium and when the potassium level is low, the response of crop to nitrogen or phosphate fertilizers is poor. Present findings are in corroboration with Mohankumar *et al.* (1971) [8] and Lebot (2009) [5].

Table 1: Performance of K-efficient genotypes for improving growth, tuber yield and starch content of Cassava (*Manihot esculenta* Crantz.)

Entry	Plant height (cm)	Stem girth (cm)	No. of tubers	Length of tuber (cm)	Girth of tuber (cm)	Tuber yield (t ha^{-1})	Starch content (%)	HCN content (ppm)
TCa14-1	197.0	10.8	9.3	32.6	15.8	33.86	28.7	82.40
TCa14-2	192.3	10.2	9.0	29.5	16.0	39.32	26.0	114.85
TCa14-3	197.6	10.3	7.3	34.4	16.8	37.13	26.6	99.45
TCa14-4	191.2	10.7	10.2	29.1	15.1	34.82	27.5	104.60
TCa14-5	193.5	12.5	6.8	32.8	16.0	36.46	30.9	86.84
TCa14-6	208.2	9.9	10.0	37.2	23.0	42.90	29.4	93.35
TCa14-7	189.9	10.2	8.8	33.5	11.6	34.87	25.7	104.05
TCa14-8	188.0	10.5	7.2	32.3	13.1	31.47	27.3	117.50
Sree Athulya	195.7	9.9	7.7	37.3	20.0	36.53	29.1	93.10
Local check (YTP 1)	217.8	14.3	7.3	40.6	24.5	38.74	26.6	86.05
SEd	9.01	0.60	0.43	1.53	0.98	1.64	0.53	2.70
CD (0.05)	NS	1.20	0.86	3.05	1.97	3.29	1.06	5.41

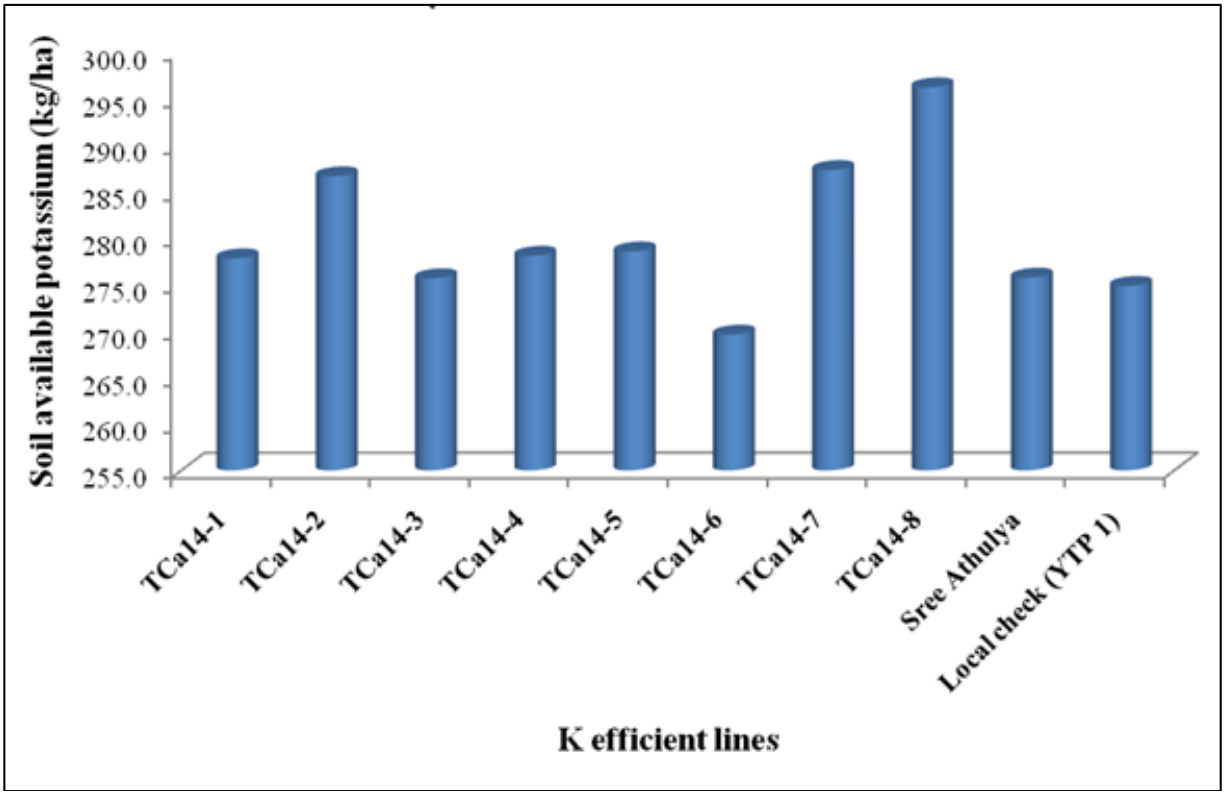

Fig 1: Post harvest soil available potassium (kg/ha) status as influenced by the K efficient lines of cassava

Conclusion

Cassava or tapioca (*Manihot esculenta* Crantz.) is one of the most important tuber crops cultivated in India. Tuber bulking and quality of starch is positively correlated with applied potassium. The main objective of the experiment is to identify the K efficient lines for maximum tuber yield and starch content. Among the K efficient lines evaluated, maximum tuber yield (42.90 t ha^{-1}) and minimum tuber yield (31.47 t ha^{-1}) was recorded in TCa14-6 and TCa14-8 respectively. The highest starch content (30.90%) was recorded in TCa14-5 and the lowest starch content (26.0%) was recorded in TCa14-2. The maximum K uptake was exhibited by TCa 14-6.

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